DISCUSSION DRAFT
Treatment Endpoints and Treatment Methods: Surface Hydrocarbons by Visual Assessment

Blacktail Creek Response Williams County, North Dakota

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1.0 INTRODUCTION

On behalf of Meadowlark Midstream Company, LLC (Meadowlark), Stantec Consulting Services Inc. (Stantec) and Cardno have prepared this report, entitled "Treatment Endpoints and Treatment Methods: Surface Hydrocarbons by Visual Assessment", as a draft proposal for consideration with respect to a release of produced water with entrained hydrocarbons along Blacktail Creek, north of Williston, North Dakota (the Site).

2.0 OBJECTIVE OF ENDPOINTS

This document outlines the process and decision-making framework that will be used to determine when it is appropriate to cease emergency response treatment operations based on achievement of incident-specific treatment endpoints, or identification of conditions that render further treatment operations potentially detrimental to worker safety and/or the environment. Proposed treatment endpoints for hydrocarbon impacts along Blacktail Creek are presented, (as assessed using commonly accepted Shoreline Cleanup and Assessment Technique, SCAT, procedures), as well as current and potential future treatment recommendations to achieve these endpoints.

The SCAT process includes eight basic steps[1]:

1. Conduct reconnaissance survey(s).
2. Segment the shoreline.
3. Assign teams and conduct SCAT surveys.
4. Develop cleanup guidelines and endpoints.
5. Submit survey reports and shoreline oiling sketches to the Incident Command System (ICS) Planning Section.
6. Monitor effectiveness of cleanup.
7. Conduct post-cleanup inspections.
8. Conduct final evaluation of cleanup activities.

As per Point 4, above, active and passive cleanup techniques (and the related guidelines) and treatment endpoints are critical to subsequent steps of the SCAT process.

Cleanup techniques are implemented through Shoreline Treatment Recommendations (STRs) to achieve treatment endpoints. Subject to agreement on treatment endpoints, conceptual cleanup techniques are presented in this document. These include both the techniques currently being employed and additional measures which may be proposed.

Treatment endpoints are mutually-agreed measurable objectives for oil removal from impacted areas within designated SCAT segments. Treatment endpoints define when sufficient treatment effort has been completed for a segment and that no further treatment (NFT) is recommended. An important component in their establishment is that the appropriate environmental agencies partake in the development to ensure that their concerns and requirements are addressed in the decision making process.

Treatment endpoints are developed to:

[1] National Oceanic and Atmospheric Administration (NOAA). 2013. Shoreline Assessment Manual. 4th Edition. Seattle: NOAA Emergency Response Division. 65 pp + appendices.

1. Identify impacted SCAT segments that require treatment;
2. Guide the selection of response strategies and appropriate cleanup tactics;
3. Define standards against which the completion of treatment can be compared so that closure can be achieved; and
4. Minimize total impact to the environment by evaluating the net environmental benefits of potential remedial actions and prevent possible over-treatment of a recovery area (and the related collateral damage) where little benefit is likely.

Having established agreed-upon endpoint criteria allows for a measurable standard to be applied to cleanup operations to reach completion. Typically, agreement that the endpoints have been met and sufficient effort has been completed occurs through a cooperative inspection process for both SCAT and sign-off inspections.

3.0 GEOGRAPHIC UNITS

Initial field surveys along Blacktail Creek were used to determine the extent of impact along the creek. SCAT segments were delineated every 200 feet from 137th Ave bridge to the west to the confluence of Little Muddy River at the east (see Figure 1). The habitats identified were the waters of Blacktail and the vegetated stream banks.

3.1 FIELD OBSERVATIONS

SCAT surveys were hindered, prior to recent thawing, in identifying the extent of oiling conditions due to the frequent frozen state of the waters of Blacktail Creek and the presence of snow and ice along the creek shore banks. Observations made during recent warming and thawing have assisted in defining conditions throughout the impacted areas. For the purpose of defining treatment endpoints, two habitat types are identified:

1. Surface waters of Blacktail Creek – defined as stream waters and pools and ponds formed by receding of the stream.
    - Light brown colored mousse (emulsified oil, a weathered suspension of oil globules in water) and rainbow sheen on open waters; and
    - Dark brown to black colored mousse entrained in ice.
2. Vegetation and ground cover along and adjacent to the shoreline of Blacktail Creek
    - Brown colored mousse coating on the surface of the vegetation.

Photographic references will be compiled and distributed by SCAT teams to regulators/trustees.

4.0 RECOMMENDED ENDPOINTS

The following recommended incident-specific endpoints are derived from field-based visual measurements and observations of oil conditions recorded by the Blacktail Creek SCAT team. They represent qualitative endpoint measurements using standard SCAT terminology, definitions and practices for North America (Appendix A).

4.1 RECOMMENDED TREATMENT ACTIONS

1. Surface waters
    - Collection booming and skimming of pooled oil
    - Adsorbent pads for collection of pooled oil
    - Collection of ice containing visible oil
    - Passive booming/snaring in back eddies or collection/low flow areas.
2. Vegetated shorelines
    - Active remedial actions such as cutting above the root system, physical agitation or wiping with adsorbent pads
    - Raking and removal of oiled vegetative debris
    - Natural attenuation and monitoring

4.2 TREATMENT ENDPOINTS

Proposed treatment endpoints for petroleum hydrocarbons related to the release and affecting the surface waters of Blacktail Creek (from the release site to the confluence with the Little Muddy River) are as follows:

- Emergency response cleanup operations shall terminate when visible oil in the surface waters of Blacktail Creek have been reduced to a sheen not recoverable with approved treatment methods (see Section 4.0) or the implementation of approved, active treatment methods would result in damage to sensitive habitats or resources that could outweigh the benefits of removing the residual oil (i.e., removal does more harm than good). Passive recovery operations such as oleophilic boom or snare anchored in areas where oil may be liberated by storms or snowmelt, adsorbent pads anchored in areas where residual oil may become present in the near future may be employed where potential for oiling still exists. It is important to recognize that active cleanup techniques may not result in a net environmental benefit but rather may increase potential injury to the stream due to increased erosion of shoreline and sedimentation of the stream bed. In such cases, natural attenuation can be a viable clean-up option.

Proposed treatment endpoints for petroleum hydrocarbons related to the release and affecting the vegetation and ground surface along the shoreline of Blacktail Creek (from the release site to the confluence with the Little Muddy River) are as follows:

- Emergency response cleanup operations of oil shall terminate when mobile or readily recoverable oil capable of being refloated does not exist on the banks or vegetation, or its removal by approved, active treatment methods (Section 4.0) would result in damage to sensitive habitats or resources that could outweigh the benefits of removing the residual oil (i.e., removal does more harm than good); and
- Emergency response cleanup operations for oil stain or sporadic coat (see Appendix A) shall terminate when an adhesive (sticky) residue does not rub off on contact (i.e., when residual oil, as opposed to weathered/desiccated residue, does not transfer when touched with a latex glove), or the implementation of such operations would result in damage to sensitive habitats or resources that could outweigh the benefits of removing the surface oiling stain or sporadic coat (i.e., removal does more harm than good).

In all cases, independent of a balance of harms analysis, Meadowlark can consider and utilize natural attenuation subject to stakeholder approval.

5.0 SEGMENT SIGN-OFF INSPECTION PROCESS

The objective of a segment sign-off inspection is to determine if the cleanup endpoints have been met for a specific shoreline segment, and to provide recommendations to the Incident Command regarding the need for additional active cleanup, passive recovery, and/or monitoring, or to identify conditions that render further cleanup operations potentially detrimental to worker safety and/or the environment.

Sign-off will be based on field observations and best available data that exists on the date the sign-off is executed. Sign-off does not preclude a lead or trustee agency to require the responsible party to conduct additional cleanup activities pursuant to any applicable laws, or in the event that additional oiling or re-oiling is discovered. The inspection process is documented on the Segment Inspection Report (SIR) Form (Appendix B).

5.1 CONDUCTING FIELD INSPECTIONS

Sign-off inspections shall be conducted by visually inspecting the shoreline to determine if cleanup efforts conducted to date have been successful in achieving the cleanup endpoint. Where possible, shoreline inspections should be conducted on foot by walking the shoreline. Sign-off inspections will only be performed once a pre-inspection has been completed and it has been determined that the segment is ready for formal sign-off inspection. Once pre-assessments have identified a significant number of SCAT segments are ready for sign-off inspection, the SCAT Team Leader will coordinate with Inspection Team Members to organize and schedule inspections.

Sign-off inspection teams will visually assess all shorelines and attempt to reach consensus with respect to one of three possible inspection outcomes:

1. **Cleanup endpoints achieved – No Further Treatment sign-off recommended**

   If the team determines by consensus that the applicable cleanup endpoints **have** been met, then the inspection team members will "sign-off" the segment, documenting that no further activities are required and that the grid or segment should be "signed-off".

2. **Cleanup endpoints not achieved – additional active cleanup recommended**

   If the team determines by consensus that the applicable cleanup endpoints **have not** been met, but additional active cleanup is required and feasible without compromising worker safety or potentially causing greater environmental harm than benefit, then specific details and recommended actions must be included on the inspection/sign-off form to assist the Operations Chief with developing response tactics (e.g., GPS locations, recommended treatments, etc.).

3. **Cleanup endpoints not achieved – additional passive recovery and/or monitoring recommended**

If the team determines by consensus that the applicable cleanup endpoints **have not** been met, but additional passive recovery is required and feasible based on considerations such as, but not limited to: further active cleanup would cause greater environmental harm than benefit, continued efforts pose unacceptable risks to worker health and safety, etc., then the specific rationale for such a determination, details, and recommended actions must be included on the inspection/sign-off form to assist the Operations Chief with developing response tactics (e.g., GPS locations, recommended treatments, etc.).

The consensus opinion of the team will be recorded on an inspection/sign-off form to be completed by the inspection team in the field. In the event that consensus cannot be reached among team members, positions and supporting rationale for each viewpoint should be documented on the inspection form. Additional comments and photos may be added or attached to the inspection/sign-off form as needed.

6.0 RECOMMENDED TREATMENT METHODS

Active cleanup of recoverable oil from the observed impacted areas, when deemed necessary, should be completed by approved treatment methods. Recommendations should come from SCAT field teams and hot spots should be addressed by SCAT supervisors to determine the appropriateness and approval of proposed treatment. Establishing the type of treatment methods employed by Operations and having interagency agreement as to allowable methods helps ensure that practical and efficient means are used for recovery, reducing long term or excessive damage to ecosystems.

6.1 CURRENT TREATMENT METHODS

Current treatment methods presently employed by Operations in removing recoverable oil include:

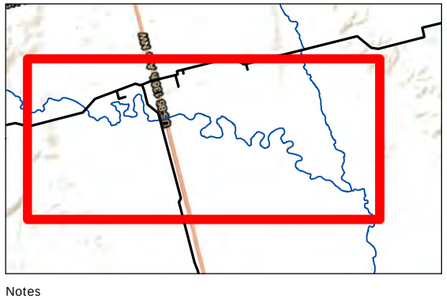
- Removal of loose/unattached duff/vegetative debris with residual oil, including loose vegetation, i.e., by rake, fork or shovel; Treatment is conducted in such a manner as to protect stream waters from oil potentially liberated by treatment of vegetation and debris. Stream protection is accomplished through booming and/or skimming.
- Surface water recovery by means of strategically placed containment (e.g., hard boom and underflow dams) directing hydrocarbon to collection by mechanical means like a hydrovac or manual means such as pool skimmers;
- Surface water recovery using sorbents such as sorbent boom, pads, permeable fabric fence (Oil Shark ™) and snare (pom-poms) (sorbents that are oiled, water-logged or breaking apart are removed and replaced as necessary);
- Removal of oiled vegetation/oiled duff and debris along shorelines and overbank areas where the oil can be rubbed off with contact (cutting is to occur no less than 2 inches above the base to avoid impact to the root structure);
- Removal of ice with frozen oil (for example, by concentrating it with chain link fence or containment boom and removing it with hydrovac or an excavator); The risks of employing heavy equipment in the stream and surrounding land will be evaluated prior to approval of this remedial strategy as damage from remedial operations could potentially exceed the benefit of removal of contaminated ice and
- Low flow, cold water deluge flushing of impacted shorelines and overbank areas to remobilize hydrocarbons into containment/collection. Should flushing be proposed, a pilot test will be conducted to assure liberated oil can be effectively controlled and captured and not result in increased impacts to the stream or shoreline.

6.2 PROPOSED TREATMENT METHODS

Treatment methods not yet in use but that can aid in the recovery of hydrocarbons are proposed as follows:

- Natural attenuation (where active treatment may cause more harm than benefit);
- Spot treatment of vegetation removal areas with light application of a hand torch (weed burner) to remove or degrade residual surficial hydrocarbons. (Consideration of the potential for increasing erosion and/or sedimentation in the treatment area must be evaluated prior to employing the technique);
- Low flow, warm or ambient temperature water for deluge flushing of impacted shorelines and overbank areas to remobilize hydrocarbons into containment/collection. (A pilot study may be warranted to further evaluate the effectiveness of this proposed method);
- Soil/sediment agitation by mechanical or manual (e.g., hard rake) means during deluge flushing operations (provided it does not cause substantial erosion). (Capture and control methodologies must be employed in conjunction with this treatment and risks should be weighed in consideration of net environmental benefit); and
- Soil/sediment removal in non-vegetated impacted areas of limited habitat value by manual or mechanical means (only to the extent of the visually oiled horizon).

FIGURE



Legend

Existing Pipeline

0 1,000 2,000 Feet

1 inch = 1,000 feet

Notes
1. Coordinate System: NAD 1983 StatePlane North Dakota North FIPS 3301 Feet
2. 2014 National Agriculture Imagery Program (NAIP) aerial orthoimagery provided by USDA's Farm Service Agency
3. Existing Pipeline Sytem provided by Meadowlark Midstream

Stantec

Project Location
Williams County, North Dakota

212205194
Prepared by TKR on 2015-03-17
Technical Reviewed by BL on 2015-03-17

Client/Project
Meadowlark Midstream Company, LLC
Blacktail Creek

Figure No.
1

Title
SCAT Segments

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APPENDIX A
Standard SCAT Terminology and Definitions

DISCUSSION DRAFT
TREATMENT ENDPOINTS AND TREATMENT METHODS:
SURFACE HYDROCARBONS BY VISUAL ASSESSMENT

Oiling Description/SCAT Terminology Definitions:

Oil Distribution Surface Oiling Descriptors

Continuous (CN)	91-100%
Broken (BR)	51-90%
Patchy (PT)	11-50%
Sporadic (SP)	1-10%
Trace (TR)	<1%

Surface Oiling Descriptors - Thickness

TO - Thick/Pooled Oil (fresh oil or mousse > 1 cm thick)
CV - Cover (oil or mousse from >0.1 cm to <1 cm on any surface)
CT - Coat (visible oil <0.1 cm, which can be scraped off with fingernail)
ST - Stain (visible oil, which cannot be scraped off with fingernail)
FL - Film (transparent or iridescent sheen, or oily film)

Surface Oiling Descriptors – Type (applicable to this response)

FR - Fresh Oil (unweathered, liquid oil)
MS - Mousse (emulsified oil)
TC –Tar (weathered coat or cover of tarry, almost solid consistency)
SR – Surface Oil Residue (non-cohesive, oiled, surface sediments)
NOO – No Oil Observed
DB - Debris: logs, vegetation, rubbish, garbage, and response items such as booms

Oil Area Width (predominantly shoreline)

Wide	greater than 6m (19 ft 8 ins)
Medium	greater than 3m and less than or equal to 6m (9 ft 10 ins to 19 ft 8 ins)
Narrow	greater than 0.5m and less than or equal to 3m (1 ft 8 ins to 9 ft 10 ins)
Very Narrow	less than or equal to 0.5m (1 ft 8 ins)

DISCUSSION DRAFT
TREATMENT ENDPOINTS AND TREATMENT METHODS:
SURFACE HYDROCARBONS BY VISUAL ASSESSMENT

Initial Surface Oil Cover Category

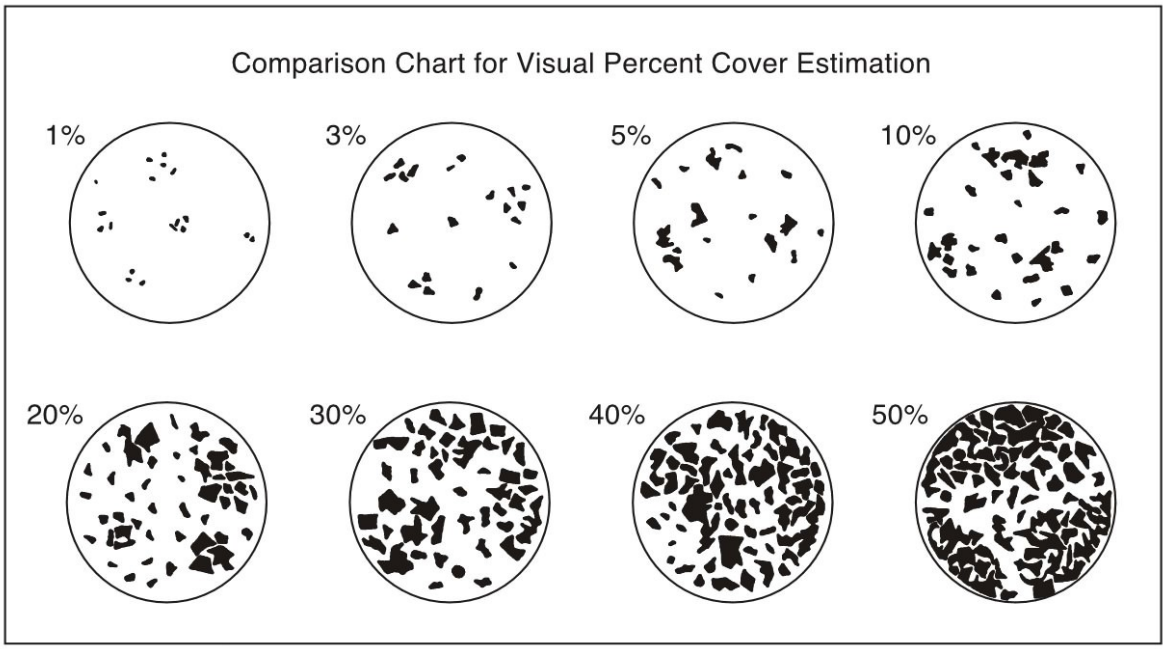
		Width of Oiled Area			
		Wide	**Medium**	**Narrow**	**Very Narrow**
Distribution	**Continuous 91-100%**	Heavy	Heavy	Moderate	Light
	Broken 51-90%	Heavy	Heavy	Moderate	Light
	Patchy 11-50%	Moderate	Moderate	Light	Very Light
	Sporadic 1-10%	Light	Light	Very Light	Very Light
	Trace <1%	Very Light	Very Light	Very Light	Very Light

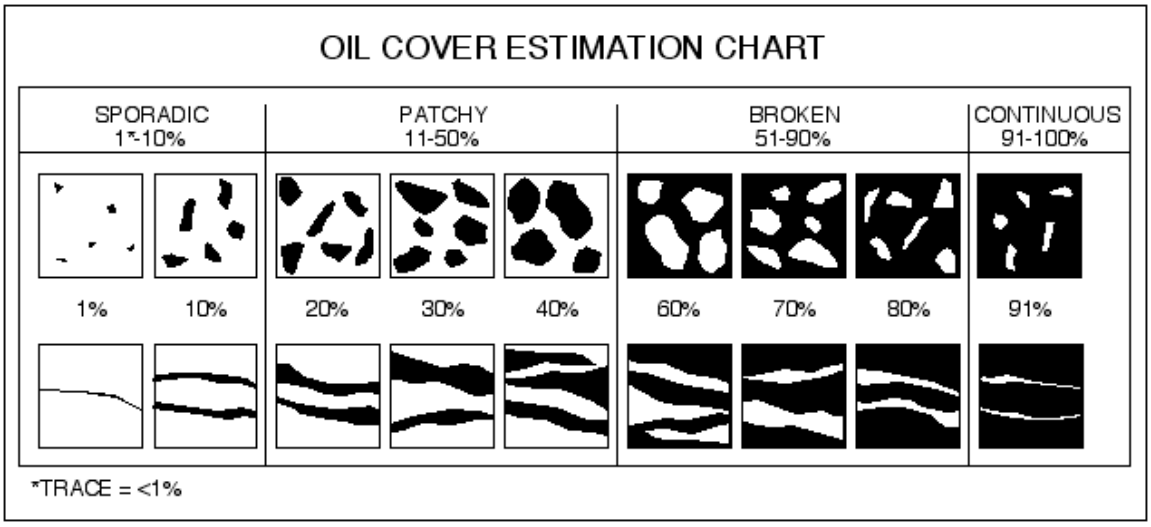
Final Surface Oil Cover Category

		Initial Surface Oil Cover Category			
		Heavy	**Moderate**	**Light**	**Very Light**
Thickness	**Pooled > 1.0 cm**	Heavy	Heavy	Moderate	Light
	Cover >0.1-1.0 cm	Heavy	Heavy	Moderate	Light
	Coat >0.01-0.1 cm	Moderate	Moderate	Light	Very Light
	Stain/Film <0.01 cm	Light	Light	Very Light	Very Light

DISCUSSION DRAFT
TREATMENT ENDPOINTS AND TREATMENT METHODS:
SURFACE HYDROCARBONS BY VISUAL ASSESSMENT

Oil Distribution Surface Oiling Descriptors Visual Aid





APPENDIX B
SCAT Final Inspection Report

SEGMENT INSPECTION REPORT

INCIDENT NAME

LOCATION	Segment ID
Operations Division	

Date of Survey _____

Time of Survey _____

Weather _____

_____

Inspection Completed Along Entire Segment?

YES NO

SCAT Team ( ) Members

If no further treatment is required, each UC rep sign below:

Name		Signature
_____	RP rep	_____
_____	NDDH	_____
_____		_____

Treatment Endpoint Criteria:

Is treatment or further treatment required? (circle one below)

YES - define below specific treatment action(s) and specific locations within the segment where required. Provide sketches, maps, GPS coordinates to Ops

NO FURTHER TREATMENT required - each UC rep sign appropriate signature box above

Comments:

Final Sign Off

Entity/Representative Name

_____ _____ _____

_____ _____ _____